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[*With the Author's Compliments.*]

"SHUT YOUR MOUTH AND SAVE YOUR LIFE:"

BEING

REMARKS ON MOUTH-BREATHING,

BY

DR CASSELLS.

“SHUT YOUR MOUTH AND SAVE YOUR LIFE:”

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REMARKS ON MOUTH-BREATHING,

*And on some of its Consequences, especially to the
Apparatus of Hearing:*

A CONTRIBUTION TO THE ÆTIOLOGY OF EAR-DISEASE.

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“SHUT YOUR MOUTH AND SAVE YOUR LIFE.”

IN this communication it is intended to demonstrate the truth of the proverb which has been chosen as its title, by showing that shut mouths and open nostrils are conducive to good health; and, conversely, that open mouths and shut nostrils are injurious, not only to the general health, but especially to the health of the organs of hearing;—to show, in fact, that neither perfect health nor perfect hearing is compatible with the habit of month-breathing; and that to shut the mouth, as the proverb enjoins, is, literally, to save the life.

It is, perhaps, unnecessary to say here, that the subject of mouth-breathing and its evil consequences, considered in a general sanitary sense, have not escaped the notice of previous observers; for, doubtless, most of us remember the quaint and vigorously-written book on this subject by Catlin, the celebrated American traveller; with this exception, however, previous writers on the subject of mouth-breathing have neither been numerous nor influential enough, besides being too ambiguous in their treatment of the question, as well as too loose in their facts, to establish in the minds of others a conviction of the truth of the evils of mouth-breathing; consequently, it has not received that amount of attention which it so justly merits.

Catlin called this mode of breathing “the most destructive of habits,” and designated it by the classical name of “*malo inferno* ;” but he, as well as other writers, have considered its evil consequences from a general sanitary aspect alone, perfectly oblivious of the fact, that the power of its evil influence fell chiefly and directly upon the organs of hearing. So far as can be ascertained, no one has hitherto called attention, as is done in this paper, to the causative relation that exists between month-breathing and deafness, and to the insidious influence of this habit in the production of the most serious pathological changes in the tissues of the apparatus of hearing; and, in this way, to many of the more serious, because unexpected, complications, and incalculable dangers, that may and do arise in the course of such tissue changes. Therefore, knowing from experience how well established these facts are, one can condone the style of language indulged in by Catlin, when he said, “If I were to endeavour to bequeath to posterity the most

important motto which human language can convey, it should be in three words, Shut your mouth."

But it has been said that previous writers on this subject were neither numerous nor influential; and to justify this statement it is sufficient to say, that no reference is made at all to it in general medical literature. Some years ago, indeed, a semi-popular article on mouth-breathing appeared in an American Journal,¹ most probably called forth by Catlin's then recently published work. With this exception, and a short paper on the general baneful influence of this mode of breathing,² by a Continental writer, no work except Catlin's is extant on the subject. Of Catlin's book it may be said that its style to some extent neutralized its influence; a style that might have appeared ludicrous, indeed, had it not been justified to some extent by the unparalleled experience of the author. Should this paper, therefore, lack the *verve* of that book, such tameness does not arise from a lessened appreciation of the evil consequences of the habit, but from a feeling that this subject ought to be treated with some approach to scientific soberness, in order that its truth may be established.

Apart from the special aspect from which I intend to view this subject, I may be permitted to say that the injunction given by this proverb is full of wise counsel, and were it acted on more generally than it is, many of the anomalous ills that afflict mouth-breathers would disappear; for in a country like ours, "where there is plenty of weather but no climate," and where the rays of the winter's sun too often fail to slant our window panes of a morning, worsted in their struggle to penetrate the almost Cimmerian darkness that envelops some of our cities, it is not possible to overestimate its value in the prevention of bronchial affections alone; while to those who breathe the purest air through a foul cavern, to which a mouthful of carious teeth may be likened, and thus unconsciously injure their health, it would simply prove invaluable. But when this advice is viewed from its physiological aspect in relation to the apparatus of hearing, it becomes replete with interest as a most valuable injunction to all who desire to retain the function of hearing perfect; or to improve it, if it has become impaired. I would also suggest to medical practitioners in general, that this proverb merits their best attention, regarded in a sanitary sense, for I feel satisfied that in their hands it might prove to be a most valuable therapeutic procedure, not only in the prevention and cure of ear-diseases, but in the prevention and cure of those ever-recurring catarrhal affections of the naso-bronchial mucous membranes, which prove so intractable under every and all forms of treatment.

Before passing on to consider the more immediate subject of this

¹ The Atlantic Monthly.

² By my friend, Dr Guye of Amsterdam, and which I heard read at the International Medical Congress in Brussels in 1875.

paper, let me place before you the following propositions, which may, meantime, be postulated, in proof that man is a nose-breather by nature. Before doing so, however, and as much in your interest as in my own, let me remind you of the rule that Descartes laid down for his own guidance in searching for scientific truth; it is as follows:—"Give unqualified assent to no propositions but those the truth of which is so clear and distinct that they cannot be doubted;"¹ and this rule I ask you to keep constantly before you in considering these propositions, in order that you may either support me in the conclusions to which I have arrived, or destroy the foundation upon which they rest.

Because that man had "breathed into his nostrils the breath of life," Catlin has asserted that man is a nose-breather by nature—a proposition that is unassailable, you will agree, if in this very scientific age opponents of this conclusion would admit the evidence founded upon; happily there are other facts, as it appears to me, that go to prove, independent of the one quoted, that he is not only a nose-breather by nature, but ought to continue to be one; and as these facts can become the subject of further investigation by those who are disposed to test the validity of this conclusion, I shall state the following propositions:—The newly-born infant can only respire by the nostrils; air inspired by the nostrils is totally different from that inspired by the mouth; disuse of the nasal passages begets abnormal tissue-changes in their structures; and, lastly, nasal breathing is essential to perfect hearing. As some of these statements may appear rather astounding, I shall show, I hope, that if they be so, they are nevertheless well founded.

The first inspiration that the newly-born babe takes is drawn through the nostrils, and if these passages be closed experimentally, the young child cannot breathe at all, even though its mouth be held open purposely. I have repeatedly satisfied myself by experiment that this statement is true; several times indeed, in thus experimenting many years ago on newly-born infants, both in those who had and those who had not breathed, I have almost carried the experiment too far, almost to complete arrest of the respiratory act—to complete suffocation, in fact.² As the result of these experiments, I emphatically repeat that a newly-born infant breathes at first by the nose only, and continues by preference to breathe through the nostrils till circumstances arise that call forth mouth-breathing.³ That air enters the nostrils of the infant before entering its mouth, is a well-established fact, for cases are on record (by Mach

¹ Discours de la Méthode pour bien Conduire la Raison et chercher la Vérité dans les Sciences.

² My friend, Dr Hugh Miller, Physician-accoucheur to the Glasgow Maternity and Lying-in Hospital, has quite recently, at my suggestion, repeated these experiments, with the result of confirming the conclusion which I have arrived at.

³ Watch a baby of a few days' old who has "snuffles," and its struggles for breath as well as its difficulty of swallowing; these may convince one that mouth-breathing only arises in some dire necessity, and is not the natural mode of respiration.

and Ogston and others) in which air was found in the tympanic cavities of the newly-born infant when no air could be demonstrated to be present in the lung-tissue.¹ That air cannot enter the tympana through the mouth, if the nostrils be closed, I will show on anatomical and experimental grounds before concluding these remarks. That air inspired by the nasal passages is totally different from, and better fitted to enter the lungs than air inspired by the mouth alone, is, I would venture to assert, the result of the experience of every one who has profited by his experience of life in the murky and fog-laden air of our cities. But a further and physiological fact may be advanced in support of the statement, that the air traversing the nostrils is different from that passing through the mouth; is changed, in fact. This inference rests upon the fact of the difference of the behaviour of the lining membranes of the nasal and mouth cavities respectively, when air is passed over them for a length of time. If any one will experiment on his own person, and note his sensations, he will discover that with prolonged mouth-breathing the lining membrane of this cavity becomes dry and parched, and the act of respiration is at last disagreeable, and may even become painful. While, with prolonged nasal-respiration, not only is there no such distressing or painful sensations as are experienced by mouth-breathers; on the contrary, the act of breathing through the nose is one of entire freedom from such annoyances, and its lining membrane, instead of becoming dry and parched, as did the mucous membrane of the mouth under like circumstances, remains moist, even becoming moister as the respiration of the air is continued. What may be the precise nature of the change thus effected on the air, other than a difference in its temperature and moisture by the respective modes of breathing indicated, is not at all apparent; but the point may be practically tested and conclusively settled by watching the behaviour of mouth-breathers and nose-breathers in one of our city fogs, or in a room the air of which is largely contaminated with the admixture of tobacco-smoke. In either of these circumstances, the coughing and sputtering and spasmodic action of the respiratory muscles of the mouth-breathers are seen to stand out in noisy contrast to the silent and peaceful breathing of those who shut their mouths. That air, therefore, is only fitted to enter the lungs after it has undergone this purifying influence of the nasal passages, surely cannot be disputed.

But there is another fact, of perhaps greater importance than those adduced, to be urged against this mode of breathing, and which has not been recognised by general practitioners, nor even by the specialist,—it is, that the habit of mouth-breathing ultimately unfits the nostrils for the free transit of the air.

¹ Indeed, so clearly is this fact established, that advantage has been proposed to be taken of it by some medico-legal jurists in cases of suspected infanticide, in which the hydrostatic test fails, as a proof that the infant had breathed.

Basing our inferences on a well-known physiological law, one might expect to find that the changes set up in the tissues of the disused nasal-passages in a case of confirmed mouth-breathing, would be of the nature of atrophic degeneration; and observation shows that this expectation is to a large extent, if not altogether, realised; so I would be disposed to regard the congestions, the ulcerations, and the various forms of hypertrophy of the Schneiderian membrane seen in such cases. Whether or not the origin or predisposing cause of these changes may consist in a loss of local tone through a deficient supply of nerve-force, is at present difficult to determine; but it is no less certain that this habit of breathing, however begun, does aggravate already existing tissue-changes, such as have been mentioned, and may, I am convinced, give rise to them *de novo*. In either supposition, probably by the deprivation of the stimulus of the atmospheric air, so I am led to conclude, from the marked improvement that speedily follows in most cases of non-specific ulceration of the lining membrane of these passages, after a few days' resumption of the natural mode of breathing, without the aid of other measures. While these are but conjectures in regard to the origin of the tissue-changes in the nostrils, the fact yet remains, that mouth-breathing leads to narrowing of the nasal passages, and in many cases to complete closure of them, just as in the somewhat parallel instance of a disused pathway becoming covered over, and at last choked up, by rank, if luxuriant, vegetation.

In regard to the last statement, that nasal respiration is essential to perfect hearing, I have to say that the positive proof of this statement falls to be taken up in the course of this paper; and here, meantime, I shall offer negative evidence only in proof that mouth-breathers are invariably dull hearers, by citing the evidence of an independent observer, viz., that of Catlin. Let me ask you, also, to observe the contrast that is established between civilized life, in which mouth-breathing is the rule, and deafness, and all forms of ear disease, painfully frequent, with that of savage life, in which there is no mouth-breathing, and no defective hearing.

In the course of his travels among the native Indians of America, Catlin visited 150 different tribes, numbering upwards of two millions of individuals, living in a savage state. Among that large number there were found only three or four deaf mutes, and not a single individual who was either dull of hearing or deaf. Nor could any of the chiefs of these tribes, who were all specially interrogated on this point, remember or even find any member of their respective tribes who had been in the slightest degree dull of hearing; and these inquiries extended back over a period of ten years previously to that time at which they were made; a result not to be wondered at, when we learn from the same trustworthy source, that in all these tribes not a mouth-breather was to be seen or found, or was even known. This latter fact is explained by the

custom and training of the Indian mothers. From their earliest infancy, Indian babies are trained to breathe by the nostrils alone, never opening their mouths except to take food or to use their tongue.¹

I shall permit you to draw your own conclusions from this evidence, only remarking again that the further proof that nasal respiration is essential to perfect hearing, will be considered at an advanced stage of our communication.

The recognition of a case of confirmed mouth-breathing is not attended by the slightest difficulty. The retracted lips, the open mouth, and other distortions of the face, the quality of the voice, and the stertorous breathing at all times, point out such an individual at once,—a conclusion which is confirmed, if such be necessary, by an inspection of the interior of the nasal passages, and by holding a mirror immediately below their orifices, and which shows, by its almost undimmed surface, that these canals are nearly, if not quite, unused for respiratory purposes.

In regard to the origin of this habit, it is difficult to say whether it is a cause or a consequence in any given case. In infancy and childhood, when all the tissues of the naso-pharynx so frequently and so readily become the site of acute nasal catarrh, breathing through the mouth in such circumstances becomes a necessity, so long, at least, as the nasal passages are partly or wholly obstructed; but the neglect to treat the nasal affection, or, if treated successfully, to correct this temporary mode of breathing, establishes it as a habit, which becomes a confirmed one, either by continued neglect or through repeated attacks of the original nasal affection.

I would remark here, that I am disposed to regard the simple nasal catarrh or “snuffles” of infant life as the result of a change in the mode of breathing from nose to mouth,—a thing all infants, after a few weeks, are prone to do, and to continue doing, unless corrected.

In regard to the treatment of a confirmed case of mouth-breathing, the essential as well as the primary step towards a cure is to break the habit; for difficult as it may be to conquer and to abandon, it can nevertheless be overcome by determined and well-directed efforts on the part of those interested. This primary step consists in shutting the mouth, and, despite the distress that this occasions, keeping it shut by a strong effort of the will. Simply closing the mouth, as is here directed, several times a day, at first for short, and afterwards for longer periods, especially when walking in the open air, cannot fail, after a time, in re-establishing nasal respiration. By-and-by, the pure cold air, at first respired with some difficulty through the hitherto disused nasal passages,

¹ These are striking facts; and, descending in the scale of creation, we find that the brutes seldom or never become deaf, except from the decay of advanced age; they are also nose-breathers.

acts in lessening the congestion and tumefaction of these canals, which at last allow of the act of respiration being carried on without distress or difficulty. When this result does not follow speedily, it may then be necessary to treat in a more formal manner the local defect in the nasal passages; nothing, however, need be said here on this point, as the principles of our art suffice to guide us in the selection of a remedy suited to the nature of the obstruction; but "*principiis obsta, sero medicina periat, cum mala perungas invulnere moras*," which is best paraphrased by the proverb that at present sounds the keynote of the modern practice of medicine and surgery, viz., that "prevention is better than cure."

While holding to the opinion that nasal breathing is the natural mode of respiring, and that mouth-breathing seldom becomes a habit in the infant till it has existed as a necessity, I, nevertheless, cannot divest myself of the influence of the fact, that nature is prone to transmit to the offspring those traits and habits that have originated and developed themselves in the parents; therefore I can conceive of the possibility, by a process of development, of the creation of a race of mouth-breathers. Still, were this proved, and not a mere speculation, I would say in all cases, correct the habit; for, as our bodies are at present constituted, this mode of breathing, however instituted, is not conducive to a healthy state either of mind or body. As a fact of experience, we find that at all ages, whether sleeping or waking, mouth-breathers are the most miserable, because the most unhealthy, of people; and if we conceive of individuals such as I have indicated becoming the progenitors of the future generations of men, it does not demand that the prophetic vision be strained to see in the not distant future, in the ordinary course of nature, sons of these sires become a race of dull-brained, badly-formed, and imperfectly developed mouth-breathing creatures, peopling a province or even a country.¹

If the general *malaise*, and the other *désagréments* referred to, were the sole effects of this mode of breathing, it would still be desirable to correct it; but, unhappily, these are not the only or the worst consequences of this habit; there are others of greater importance in relation to the apparatus of hearing, that make it a matter of vital importance that this pernicious practice be overcome and finally abandoned; and we now proceed to inquire into the nature of this relation.

¹ *Verb. sap.* If you find the baby's mouth open during sleep, close it; for the sleep of the mouth-breather, whether infant or adult, is restless and unrefreshing, because unrestoring. And need I point out the consequences that can ensue to the human organism from the continued deprivation of sound refreshing sleep, "the loveliest, since it dreams the least"? Such sleep as this seldom visits the mouth-breather, seldom visits him at least in its true character, as "life's nurse sent from heaven to create us anew day by day;" with consequences to him not difficult to imagine.

In order to show the relationship that subsists between mouth-breathing in its confirmed form, and disease of the apparatus of hearing, as well as the sense of hearing itself, it is necessary to state, in somewhat general terms, that the integrity of this apparatus, and therefore of the sense of hearing, is only maintainable by a certain degree of intra-tympanic tension, which, under all circumstances, bears a constant relation to the air-pressure on the outside of the membrana tympani, and that any, even the slightest disturbance of this normal degree of intra-tympanic tension is followed by defect of function, and, if long continued, by tissue-changes in the apparatus of hearing. Now as this normal degree of intra-tympanic tension, so necessary to the preservation and economy of the organs of hearing, is only possible when the nostrils are open, and nasal respiration carried on, and, on the other hand, disturbed at once, in a greater or lesser degree, by any narrowing (or closure) of these canals—a condition which frequently precedes, and is always aggravated by, mouth-breathing—it becomes apparent that the cure of this habit is an important matter on other than purely æsthetic or sanitary grounds.

But it may be asked, What evidence is there that warrants the assumption of this hypothesis of a normal degree of intra-tympanic tension as necessary for the maintenance of the integrity of the tissues of the ears and normal function? and further, What is the evidence that supports the statement, that this normal degree of tension is only possible while the nostrils are open, and disturbed so soon as they become narrowed or closed, and mouth-breathing as a habit established? Before bringing forward this evidence, it seems necessary to recall briefly to one's mind the rôle which the act of deglutition plays in ventilating the tympanic cavities, and in adjusting the normal intra-tympanic tension when it has become suddenly disturbed; and also, incidentally, how this same proceeding (the act of deglutition), under other circumstances, still in itself acting normally, becomes an active power, not in ventilating the ears nor in adjusting their tension, but in causing a disturbance, already begun in their tympanic tension, to intensify itself.

With the completion of the first stage in the act of swallowing, the nasal passages and the upper pharyngeal space are almost completely shut off from the pharynx. In the second stage of this act the pharyngeal constrictors close by reflex action on the morsel of food or saliva, and force it onwards in its course to the stomach. With this contraction of the pharyngeal muscles, however, there takes place also a contraction of those muscles that preside over the Eustachian canals—the tube-muscles—whereby these canals are more or less opened, and the tympana are ventilated; in other words, every act of swallowing is accompanied by a contraction of the tube-muscles that opens the Eustachian canals, permitting of the free ingress and egress of the external air to the tympanic cavities.

This act of ventilation not only takes place under ordinary states of atmospheric pressure, but sudden and violent changes in its density, which might do serious injury to the ears, are obviated by the involuntary act of swallowing on our part, and the unconscious adjustment, so far as we are concerned, of the tension of the apparatus of hearing in these altered circumstances.¹ Besides this extraordinary ventilation of the tympana (which by the way, I regard as a reflex action as distinct in character as are the contractions of the pharyngeal muscles on a morsel of food), there is the ordinary unceasing interchange of air to and fro by the Eustachian canals, whereby, for the ordinary purposes of hearing, the normal balance of tension is kept uniform. Now, the position of the tube-orifices on the lateral aspects of the naso-pharyngeal cavity, in relation to the posterior openings of the nasal canals and that of the mouth, leaves us in no doubt, even were this not capable of further proof, that the air for the purposes of ventilation of the ears can pass along the nostrils only, and that when these are in any way narrowed or closed so as to hinder, or altogether to obstruct its free passage, the normal ventilation of the tympana becomes impossible.² As already stated, the sole effect of swallowing with open nostrils is to ventilate in a more perfect manner the ear cavities; but so soon as the nostrils become narrowed or closed, every act of swallowing reacts upon the tympana and the apparatus of hearing in the following way: The contraction of the pharyngeal constrictors, acting like an exhaust-pump, withdraws the air from the naso-pharyngeal cavity, and by-and-by from the tympana also. In this manner the quantity of air in the tympana is lessened, *pari-passu*, with the tension of these cavities. As no new supply of air reaches these cavities, or can reach them, otherwise than under peculiar circumstances, so long as the nostrils are in the state here supposed, it follows that serious changes, both in regard to function and tissue, may take place, and do indeed occur, as clinical observation shows conclusively.

That air passes into the cavities of the middle ear to and fro, as above indicated, with every act of respiration through the nostrils when the mouth is closed, and cannot do so when these circumstances are reversed (*i. e.*, when mouth-breathing is temporarily instituted with closed nostrils), is proved in those cases in which the membrana tympani is abnormally thin; here, in the circum-

¹ I have frequently experimented on split-palate cases, and proved what I say in the text.

² Left-ear deafness, so long a mystery as to its origin, is explained by the fact that the ventilation of this ear is always more liable to disturbance, owing to the natural narrowness of the left nasal passages, and to their becoming more readily occluded by a congestion of their tissues as compared with the right nares, which, in 80 per cent. of the patients afflicted with deafness, is wider and roomier than that of the left side. But when, as happens now and again, we have a case of decided right-side deafness, with the left unaffected, we find invariably that the right nares are narrower than the left, which in such cases are roomy beyond ordinary experience.

stances first supposed, the membrane may be seen to move outwards and inwards simultaneously with the respiratory motions, but this phenomenon is only met with when the respiration is nasal and the Eustachian tube quite normal; it ceases at once on closing the nostrils and breathing by the mouth alone.

In proof of the statements already advanced—viz., that a certain degree of intra-tympanic tension is necessary for perfect hearing, that disturbance of this normal degree of tension is at once followed by impaired function and tissue change, that this disturbance most readily arises from non-nasal respiration (or mouth-breathing), and that it is only maintainable by open nostrils and nasal breathing—let the following simple and convincing experiment be performed, by one, *whose ears and the whole apparatus of hearing are perfect*, upon himself. With the forefinger and thumb close the anterior orifices of the nasal passages, and while they are thus closed, perform the act of respiration by the mouth. Now and again, quite involuntarily, the saliva, collecting in the cavity of the mouth, finds its way to the pharynx, and causes its muscles to contract. This act of swallowing, repeated several times, calls forth a series of sensations that did not exist previously to the institution of the experiment, nor till the act of deglutition had occurred once or twice in rapid succession. The sensations of which the experimenter is himself conscious are as follows:—In a greater or less degree, a feeling of tightness in the ears, perhaps a little vertigo, and a varying amount of subjective aural-tinnitus, in addition to which there is very considerable dulness of hearing, especially of articulate sounds. It may now have been noted that the simple act of respiration through the mouth, with the nostrils closed, did not cause any of the sensations just named, but so soon as the pharyngeal muscles contracted several times in rapid succession, they were at once experienced in varying degrees of intensity, and that they continued so long as the cause or conditions that called them into existence continued to act; removing simply the obstruction that closed the nostrils, and swallowing the saliva several times, caused these symptoms to vanish as rapidly as they were created. On the other hand, the act of deglutition performed with *open* nostrils fails to produce any appreciable effect on the ear other than the natural ventilation of the tympanum. Certainly it fails to call forth the train of phenomena above described as the result of the act of swallowing with the nostrils *closed*.

This experiment, apart from the object of proof for which it was undertaken, enables the experimenter to form his own estimate of the painful consequences that arise out of a nasal catarrh which closes the nostrils so that breathing through them is no longer possible; while it enables him to realize somewhat of the nature of the affliction under which mouth-breathers may suffer in a greater or less degree for a whole lifetime perhaps.

In the above detailed experiment it is hardly possible to deny

that all the subjective phenomena were the direct result of closing the nostrils; but it may be asked if it be a warrantable inference to say that they were the expression of disturbed tympanic-tension. That this is a just and a true inference is susceptible of proof as follows; meantime, it may be helpful to the better comprehension of this proof if I say that, in the above experiment, the air in the tympanum was sucked out by the sucker-like action of the contracting pharyngeal muscles in the act of deglutition, creating thus a disturbance in the tympanic tension, and calling forth the subjective sensations that were experienced, and which again passed away so soon as the tympanic tension was restored by the act of swallowing, while the nostrils were no longer closed; in this way giving entrance to air which passed into the tympanum.

That these symptoms were the expression of disturbed tension, and that this disturbance was the direct result of diminishing the air in the tympanum, as in the above experiment, is proved as follows:—Let the *membrana tympani* be inspected ocularly, and its movements noted while this experiment is in process of execution; it will be seen to remain unaffected by the act of respiration by the mouth, although the nostrils be closed, but so soon as swallowing takes place in these circumstances, this membrane becomes more concave than normal, and congested as well, this concavity and congestion increasing with each act of swallowing. Simultaneously with the first movement of this membrane inwards all the symptoms above noted are called forth in their order, and these intensify themselves as the curvature of the membrane inwards increases, which it does with each additional contraction of the pharyngeal muscles. If now the membrane be still kept under observation, and the act of swallowing be performed with the nostrils free from all obstruction, it may be seen with each such act to regain gradually its normal curvature, sometimes to regain it at a single bound; while at the same time, and in an equally gradual or sudden manner, the subjective sensations and the congestion of the membrane pass away. Thus it is seen that the changes in the curvature of the *membrana tympani* coincide, and are simultaneous in their production and removal with the production and removal of the subjective phenomena, and that these were created solely by the act of swallowing with the nasal passages closed.

The fact that an immediate change in the abnormal curvature of the membrane, and a return to its normal concavity, together with relief from the disagreeable symptoms so frequently mentioned, take place at once on the act of swallowing with the nostrils open, proves also the absolute need of unobstructed nostrils and nasal breathing as the chief, if not the sole, condition for the maintenance of the normal intra-tympanic tension, and therefore of perfect hearing.

It is here that the causative relation that exists between the confirmed habit of mouth-breathing and ear-disease is seen clearly,

because nasal respiration in such circumstances is no longer possible, as has been already shown; and here it has been established that nasal respiration is essential to perfect hearing, as well as to the integrity of the tissues of the organs of hearing.

These facts in proof are themselves proved to be real by fixing in the meatus a manometer, the column of mercury in the instrument by its movements indicating the variations in the density of the intra-tympanic air, and therefore the changes that take place in the curvature of the membrana tympani. As an evidence that the external column of air is an important factor in the causation of the subjective symptoms already noted, when the intra-tympanic air is rendered denser or rarer as in the experiment, it is only necessary to close hermetically the outer orifice of the external meatus of one ear before the experiment is begun, and after it is being carried out. With each act of swallowing all the subjective sensations are called forth in the unprotected ear, while in the other, if the meatus, before and during the experiment, be hermetically occluded, not the faintest sensation is experienced.

Now, while this contrast is being noted, let the obstruction to the entrance of the air into the closed meatus be removed; in an instant these subjective sensations are felt in it also with equal intensity to those felt in the first instance in the other and unclosed ear; these passing away equally, as in the former experiment, on the readmission of air into the tympanic cavities. If instead of occluding the meatus, as in last experiment, with the finger-tip, we close it as effectually with an instrument devised to permit of the membrane being ocularly examined while the air is excluded from the canal,¹ it can be seen that, so long as the air is excluded from the meatus, no movement takes place in the membrana tympani thus protected, and therefore none of the subjective sensations indicative of disturbed tension are felt. But on the instant that the air is admitted to exercise its influence upon the external surface of the membrana tympani, that structure is seen to move suddenly towards the tympanic cavity, and, simultaneously with this movement, the sensations already described are at once felt.

The evidence here given in support of the statements, that a certain degree of intra-tympanic tension is necessary for the perfect function of the apparatus of hearing, and that open nostrils and nasal respiration are essential factors in the maintenance of this normal balance of tension between the intra- and extra-tympanic air-pressures, is considered sufficient and conclusive; but were it otherwise, and necessary, further evidence could be adduced in proof that the hypothesis here briefly referred to in general terms is a real and a thinkable one; because not only does it include and explain all the facts of hearing, but it explains much that pertains to aural pathology, and affords a firm foundation on

¹ Siegle's speculum does very well, if carefully fitted to the orifice of the meatus.

which to build a rational theory of the *Ætiology* and *Evolution* of ear-disease.

Coming now to consider the relation of mouth-breathing to the causation of ear-disease, we see that when the nostrils are wholly or in part closed, from whatever cause—a state of matters always existing in those who are mouth-breathers—the same series of phenomena take place in a greater or less degree, and with varying rates of rapidity, as were created by the preceding experiment, with this marked difference, that while in the case of the experiment the sensations called forth are relievable by an act of the will on the part of the experimenter, the symptoms instituted by the habit of mouth-breathing are not removable at all in this way, but in many cases continue, despite all treatment, while more serious pathological changes are set up in the tissues of the organs themselves.

Some of these changes may be very briefly referred to here:—Thus, if the normal intra-tympanic tension be disturbed in any way, besides calling forth at once dulness of hearing, giddiness, aural tinnitus, etc., the following changes take place after a time in the tissues, if the disturbing cause remains unremoved: the membrana tympani becomes more and more concave after a time, and its vessels become congested; its fibrous laminae become atrophied by the continuous one-sided pressure, and it finally collapses in its entire extent; at the same time the ossicular chain, suffering from the same cause, and sharing in the evils accruing to the membrana tympani, becomes at last immovable, from stiffening of their delicate articulations and impaction of the base of the stapes. The tendon and ligament of the tensor tympani, relaxed at first by the changes above described, in time contract, so that were it possible, which it seldom is, to remove the other consequences of altered tension, this contracted tendon and ligament mars the best efforts of the practitioner to effect an improvement. In many cases this series of changes may be all the physical tissue-changes recognisable, the characteristic symptoms being gradually increasing deafness and distressing tinnitus, which diminishes or altogether passes away as the deafness deepens. Or a different, and in some respects more serious, set of changes are instituted; thus, in acute nasal catarrh the congestion of the naso-pharynx, by continuity of tissue, invades the Eustachean tubes, which in consequence become concentrically closed; in such a case the ventilation of the tympana, already impaired by the habit of mouth-breathing, is at once arrested, and the following further changes ensue: the air shut up in the tympanic cavities is speedily disposed of, and passive congestion and engorgement of the lining membrane of this cavity follows as a result of the diminished pressure. If this state be unrelieved by art, nature steps in to supply the need. From the highly-engorged membrane a free serous transudation takes place that speedily fills the tym-

panum, giving relief, to some extent, for a time to the more pressing symptoms.

The issues of such a case are various—indeed its possibilities and its dangers are incalculable—for the more acute symptoms subsiding, and the absorbable portions of the effused fluid becoming removed, there comes an improvement in the hearing power, but never a complete restoration of it, so long at least as the habit of mouth-breathing is continued: or the unabsorbed portions of the effusion becoming organized, and forming true and false bands of adhesion that bind the structures to each other, may effectually hinder even this temporary and limited restoration of the hearing. In many cases, again, the lack of conservative remedial measures at the fitting time allows of a rude form of natural cure taking place; in such circumstances the *membrana tympani*, “giving way” before the imprisoned fluid in the tympanic cavity, an otorrhœa is established, of which neither the consequences nor the end can be foreseen.

In regard to the treatment of cases of dulness of hearing, or other more serious tissue-changes in the apparatus of hearing due to this mode of breathing, there is much difficulty; each case, after a careful study of its possibilities, and of its impossibilities as well, must be decided on its merits. If the disturbance of tension has existed for a length of time sufficient to give rise to some of the changes that I have described, no treatment may suffice to relieve the symptoms most of all complained of by the patient, or to avert more serious issues. Nay, the nostrils may be made to re-fulfil their office, the Eustachean tubes made patent, and the injunction to shut the mouth strictly followed; and, nevertheless, all may fail to afford the smallest improvement in the hearing, or even to arrest the progress of the tissue-changes that must inevitably end in deafness more or less complete.

Such are some of the changes that mouth-breathing can institute in the tissues of the apparatus of hearing—consequences, I may say, that are to a large extent preventible, if all classes of society, at all ages, rich and poor alike, would shut their mouths and breathe through their noses; and thus, saving their lives, prove that the proverb, which has been chosen for a title, is a true one.

